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Advantages of RHYTHM® In A Build To Order Environment

Executive Summary

Over the past decade, the high technology manufacturing industry has been rocked by rapid price erosion, accelerating product proliferation, and shorter product life cycles. None of these trends shows signs of abating in the foreseeable future. Consequently, manufacturers are increasingly turning to the tools and disciplines required by Build-To-Order (BTO) supply chains to deal with these challenges.

Extreme performance supply chains, characterized by high-speed BTO operations, are adept at dealing with many of the challenges in today's manufacturing environment. Some of the major benefits from high-speed BTO include:

- Inventory Lean Environment. With customer information propagating through to the raw-materials level, there is no need for finished goods inventories or large safety stocks at any of the intermediate manufacturing, storage, or transportation points
- Higher Velocity. Finely scheduled supply chains from raw materials to customer can minimize the "touch time" of the product and minimize the time products need to stay in inventory. Optimized scheduling assures that no product is started if it is going to end up waiting for a key part at a point in this process
- Reduced Depreciation Exposure. Products that are already ordered at fixed prices face no depreciation risk en-route from raw materials into the customer's possession. The later components are purchased, the greater the opportunity to take advantage of component price reductions.
- Reduced Exposure to Demand Volatility. As products proliferate, the reliability of forecasting at the finished good level declines rapidly and the total level of inventory required to maintain service levels starts to increase exponentially. Avoiding finished goods inventories allows manufacturers to maintain service reliability without prohibitive inventory levels and the risks associated with them.
- Faster Product Transitions. Without finished goods to clog the channel, new products reach customers with less delay.

To take advantage of the benefits of a high-speed BTO supply chain, manufacturers will need a set of five basic skills:

- Planning Under Uncertainty. The ability to plan effectively despite high levels of uncertainty in the system.
- High Fidelity Planning. The ability to plan operations to a high degree of granularity and accuracy.
- High Speed Planning. The ability to conduct planning quickly, to constantly do "what-if" analyses and quickly propagate changes to plans throughout the system.
- Event Driven Planning. The ability to do planning around events, such as new product introductions, rather than on a fixed monthly or weekly cycle.
- Global Visibility. The ability to monitor activities in the supply chain constantly, even when they occur outside enterprise boundaries, and then use that information for rapid and effective re-planning as needed.

With these capabilities in place, high tech manufacturers can begin to capture significant revenue upside opportunities as well achieving sustainable cost reductions. The challenge for manufacturers is that to implement high-speed BTO requires a 100-fold improvement in decision-making speed and a 1000-fold improvement in information flows to achieve a 10-fold improvement in the speed of physical goods to the final customer. The i2 Rhythm suite of software and the associated diagnostic and implementation services help manufacturers implement the basic capabilities they need and deliver the speed and reliability in planning that is required to make dramatic improvements in capability.

Between a Rock and Hard Place

Over the past decade, high tech manufacturers have increasingly found themselves squeezed by standardization and price competition, rapid technological change, and rising customer demands. The results are apparent for all to see: eroding profit margins, rapid depreciation of inventory assets, and shortened product life cycles. The substantial opportunity to improve margins and capture market share is driving the transition from build-to-stock supply chains to build-to-order (BTO) supply chains.

To successfully ride the BTO wave, supply chains must balance two competing urges: the need for speed and the value of depth. The need for speed stems from the pressure by end-users to gain immediate access to new products and new technology. The value of depth comes from the efficiency gains that are possible when customer information is propagated deep into a supply chain.

Going Faster

The need for speedy access to new technology by the end-consumer is not an irrational conditioning that customers have gained from years of buying consumer electronics off-the-shelf. It is a rational reaction to the same forces that all high-tech supply chains face: rapid technological change and obsolescence. Hardware costs represent just 15% of the total spending on information technology solutions, yet it is the most rapidly depreciating part of the equation, and hardware replacement drives many of the expenses in the information technology solution. As a result, some high-tech customers are adopting strategies that may increase total time between upgrades:

- Standardization. Increasing standardization and inter-operability of technical solutions reduces risk during transitions.
- Start of Life Cycle Acquisition. Purchasing products at the start of a life cycle is a strategy to maximize the time between required upgrades.
- Product Life Cycles Linked to Technology. There is no value in buying a new product if it is based on technology that is at the end of its own life cycle.

While not all customers use these strategies, other customer requirements can place different burdens on the supply chain. In the PC segment, some corporate customers want to lock-in specific configurations over a period of 9 months, which may exceed the normal product life cycle. In other cases, customers may value high-speed availability more than price - expecting delivery of customized solutions in days or hours, or demand local service presence.

As manufacturers, these varying customer strategies only intensify the pressure on supply chains. Standardization leads to commoditization, intensified competition and reduced margins. As long as the pace of technology introductions increases, product life cycles will shorten. The desire to link life cycles of end products to the underlying technical change demands ever greater speed of coordination across the supply chain. Lastly, expectations of rapid delivery regardless of the complexity of the product can lead to low customer satisfaction even when manufacturers break every previous record for speed.

Going Deeper

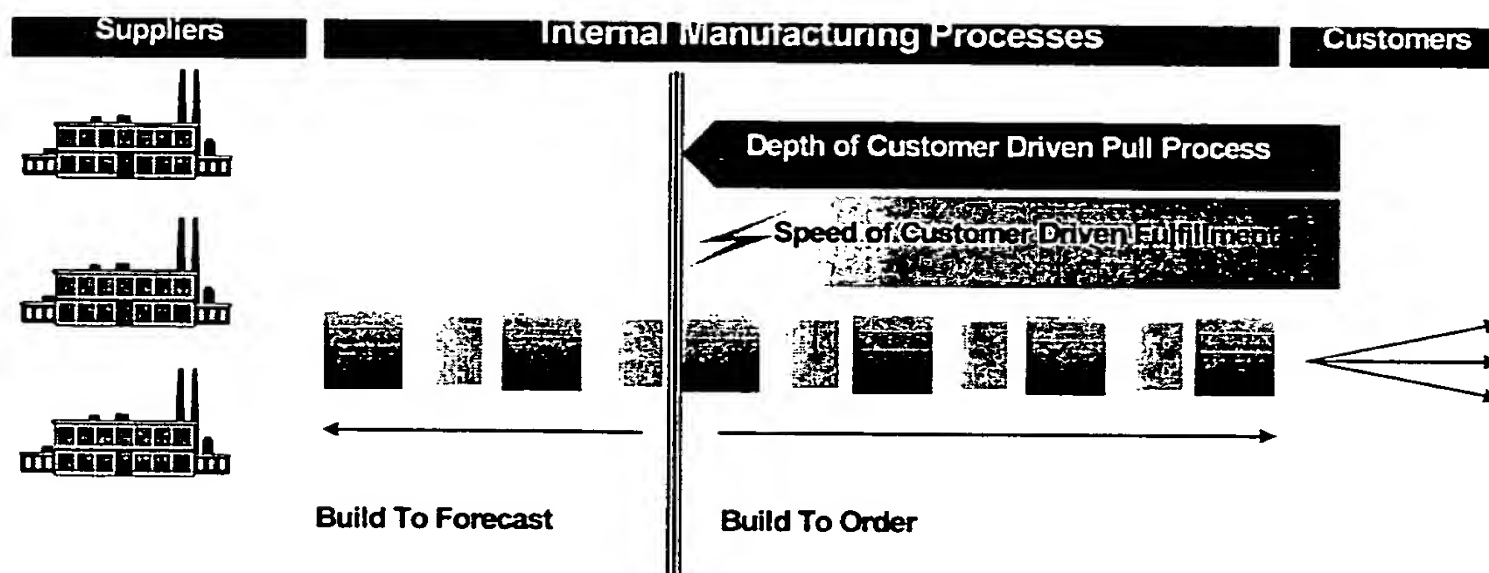
The value of “depth” comes from the increased ability of companies to coordinate activities across the length of the supply chain. A BTO supply chain is characterized by the tight linkage between planning and execution systems. Some key features include the ability to link a customer order to a manufacturing order, pegging the manufacturing order to required materials and capacity, eliminating finished goods inventory and drastically reducing work-in-process inventories. The benefits to supply chains from having customer information deeply embedded in the system are significant:

- Inventory Lean Environment. With customer information propagating through to the raw-materials level, there is no need for finished goods inventories or large safety stocks at any of the intermediate manufacturing, storage, or transportation points
- Higher Velocity. Closely coordinated supply chain operations from upstream supplier production, through purchasing, final assembly, distribution, and delivery can minimize the total “touch time” of the product. Optimized scheduling assures that no product is started if it is going to end up waiting for a key part at a point in this process
- Reduced Depreciation Exposure. Products that are already ordered at fixed prices face no depreciation risk en-route from raw materials into the customer’s possession. The later components are purchased, the greater the opportunity to take advantage of component price reductions.
- Reduced Exposure to Demand Volatility. As products proliferate, the reliability of forecasting at the finished good level declines rapidly and the total level of inventory required to maintain service levels starts to increase exponentially. Reducing finished goods inventories allows manufacturers to maintain service reliability without prohibitive obsolescence liability and carrying costs.
- Faster Product Transitions. Without finished goods to clog the channel, new products reach customers with less delay. This is particularly powerful for supply chains that have indirect channels to the end-customer.

Being Balanced

Success in using BTO wave centers on balancing the desire of manufacturers to “go deep” with the desire of customers to move quickly. The depth of customer information in the supply chain is limited by the amount of time that the customer is willing to wait for the product. In consumer electronics, that remains about five minutes, but as Dell and Gateway have demonstrated, even for increasingly “consumerized” products like PCs and home-office equipment, customers are willing to wait up to a week or longer in order to receive exactly what they require.

Choosing The Best Position for BTO



The disciplines and set of tools that are used to develop high performance supply chains not only permit customer order information to be passed ever deeper into the supply chain, the same tools and disciplines can be used to speed of the entire supply chain, so that the "depth" achievable in a given amount of time can be dramatically increased as well. High performance supply chains based on BTO weather changes in demand and frequent product introductions much more robustly than traditional build to stock supply chains.

To take full advantage of the transition to BTO supply chains, high tech manufacturers need five basic capabilities:

- Planning Under Uncertainty. The ability to plan effectively despite high levels of uncertainty in the system.
- High Fidelity Planning. The ability to plan operations to a high degree of granularity and accuracy.
- High Speed Planning. The ability to conduct planning quickly, to constantly do "what-if" analyses and quickly propagate changes to plans throughout the system.
- Event Driven Planning. The ability to do planning around events, such as new product introductions, rather than on a fixed monthly or weekly cycle.
- Global Visibility. The ability to monitor activities in the supply chain constantly, even when they occur outside enterprise boundaries, and then use that information for rapid and effective re-planning as needed.

This white paper examines the size of the opportunity created in the transition to BTO supply chains, the role each of the five basic capabilities plays, and how those broad skills are reflected in day-to-day planning and execution capabilities. This paper is written from the perspective of a build-to-stock manufacturer making the transition, but the skill sets described are equally applicable to BTO manufacturers attempting dramatic reductions in cycle time.

Sizing The Opportunity

The size of the market opportunity available from superior supply chain management is substantial in cost savings alone. More than cost savings are at stake, however. Leaders in the high technology manufacturing industry can take advantage of the dominant trends in the market-place to open a substantial performance lead over their competitors using the most advanced supply chain management tools.

For manufacturers, there are four major opportunities that can be exploited in the transition to BTO supply chains. These opportunities include:

- Capturing Perishable Demand
- Managing Frequent Product Transitions
- Demand Creation Through Differentiation
- Achieving Sustainable Cost Reductions

Capturing Perishable Demand

There is growing evidence that late deliveries and stock-outs inflict significant performance penalties on high-tech manufacturers. A recent joint study by Andersen consulting and the Stanford University Supply Chain Forum¹ found that even brief product shortages caused rapid erosion in market-share in the PC industry. The study's findings are further supported at a higher level by long-term tracking of the entire computer industry done by McKinsey & Co., which demonstrate consistently that companies whose position relative to their competitors starts to decline rarely recover and regain share². In the fight for market share, product availability is the key to success.

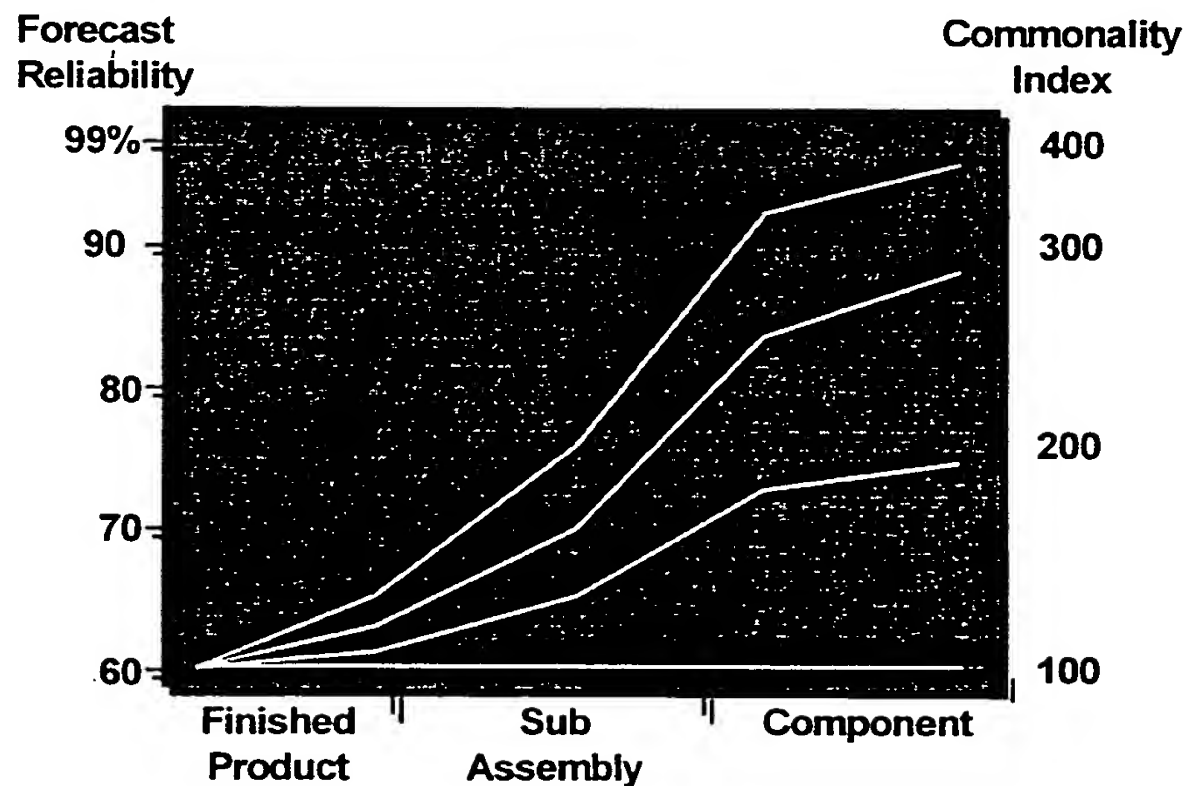
¹ Creating Value in the PC Industry Supply Chain, Andersen Consulting and Stanford University, 1997

² The Annual Report on the Computer Industry, McKinsey & Co., Inc., 1997

The length of time that customers are willing to wait for high technology products has been declining as the rate of technological change and product depreciation has been rising. When combined with the surging number of SKUs available in many high tech industries, the result has been to strain the ability of even the best-run build-to-stock systems to keep up. As demand becomes more volatile for each SKU, the amount of inventory required to maintain service levels rises and quickly becomes prohibitive. The result is a continuous series of stock-outs on hot products and inventory pile-ups on slow-sellers.

The most effective strategy for planning under uncertainty is to transition from a forecast-based push system into a demand-based pull system. Forecasting at the component level, rather than at the finished goods level actually improves forecast accuracy, by exploiting commonality of products such as chips and drives in end items.

Anchoring Planning On Components



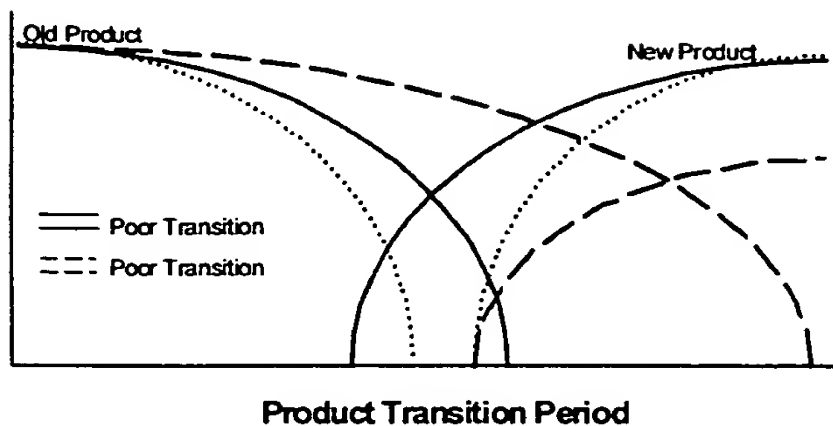
By making and acting on forecasts at the component level or sub-assembly level and increasing component commonality across products, manufacturers can increase their order-fill rates and reduce stock-outs. Based on i2 Technologies' experience conducting performance diagnostics for clients in the PC industry, increasing order fill-rates from 80% to 85% would add \$90 million in revenue and \$10 million in net profits for a typical PC company.

The impact of build-to-order on supply chains and the competitive edge it confers increases as the full set of capabilities are implemented. Adding the ability to manage component-level allocations and available-to-promise information enables manufacturers to reserve scarce components or capacity for those products which generate the highest margins and quickly promise against or refuse orders which meet the company's business objectives. Maintaining manufacturing flexibility at the parts level under a BTO strategy creates opportunities to improve product mix of critical high value parts across multiple product families.

"Profits are made in the transition"

The value at stake in product transitions is now the key to profitability for many manufacturers. The risks and gains possible in the transition period have always been substantial, but as product life cycles get shorter, the portion of revenue and profit generated in the transition period has grown ever larger. Done right, product transitions capture the superior margins that exist at the start of the cycle and avoid heavy discounting to clear channels at the end. As many high tech manufacturers and i2 Technologies clients now begin to manage more than 200 product transitions yearly, effective event driven planning can make the difference between industry leadership and declining market-share.

Significant costs of poor product transition - example



Poor product transition risks include:

- Slow ramp-up in sales as excess inventory is removed from the system
- Period with insufficient supply of new products
- Costly inventory write-offs

For a product with a 12 month life cycle, transition risks are considerable:

- Lost up to 20% of total product revenue
- Lost up to 20% of profits from lost sales
- Lost up to 25% of profits from inventory write-downs and obsolescence

For a \$1 billion product line with 10% net margin, this is:

- \$200 million in revenue at risk
- 20-45 million in profit at risk

High performance supply chains that build-to-order significantly reduce the risks of product transitions. Without finished goods inventories clogging the channel, new products will reach the final customer faster, nor will there be old inventories that require heavy discounting to clear away. The discipline required by build-to-order systems to increase the level of component commonality across products and product generations generates increased benefits in product transitions by reducing the risk of component shortages that might delay product introduction.

The timing of product transitions is another major hurdle for manufacturers. The increase in standardization of high-tech products increases the risk that product transitions must often respond to competitive actions, being brought forward to meet new challenges or pushed back to cope with supply delays or take advantage of slower competitive response. Adjusting transition dates with a high level of speed and accuracy is easier in build-to-order environments. The two main challenges are identifying changes in the market place quickly and managing the cascading effects of changing product transition dates.

In the first case, detecting changes in the market-place can take place much faster in a BTO environment. While changes in demand of forecast often take weeks or months to be reflected in traditional Build To Stock environments, BTO supply chains reflect demand changes much more quickly, and more importantly, can respond just as quickly. Though fast reaction time is a powerful asset, there is an attached risk for supply chains without strong collaboration tools - indirect channels that do not pass on actual order information may confuse manufacturers by not differentiating between orders placed for actual customers and those placed to meet forecast demand.

The ability to respond quickly depends entirely on the linkage between core planning processes during the transition period and is a prime illustration of the value of high fidelity planning. As product transitions move in or out, it is attention to detail that sets apart the leaders from the laggards.

Having a high fidelity planning system means that even small details are accounted for in the planning process. For example, if a product transition was pushed out and additional units of the original product were required, the planning system must be able to represent and plan for alternates at multiple levels if it is to identify new-revision parts for the new product that are also acceptable for use in the original model. If planners had to scrutinize the thousands of changes required by moving a product transition date for errors line-by-line, the freedom to make those changes would be dramatically limited.

Demand Creation through Product Differentiation

Marketers have always known that one of the surest ways to win new sales was to offer a product that precisely fit a customer's needs. Manufacturers, conversely, have always been aware of the power of standardization. The three "rules" of traditional manufacturing were outlined in a recent article in *the Sloan Management Review*: (1) reduce the impact of customers' variability on internal operations, (2) do so by identifying general product and customer categories and (3) simplify and streamline interactions with the customer.³

³ Customizing Customization, The Sloan Management Review, September 1996

The result has been industries "driven by the logic of aggregation" and the constant reduction in the level of segmentation of markets. The same 1996 article in the *Sloan Management Review* cited the case of hospital beds, which were once offered in 33 different sizes and are now offered in just one or men's hats which came in 100 colors at the start of the century and just 20 years later in just 9 colors. Since that time, manufacturers have begun to segment their markets more finely as manufacturing tools allowed them to capture the efficiencies of mass production while offering more variety. Build To Order is the logical extension of this trend, slashing the cost of product proliferation. How many product varieties would your organization offer if variety cost nothing?

Market segmentation in high tech manufacturing is more difficult than in many industries, however. In particular, segmenting based on quality is no longer an option - outstanding quality is merely an entry requirement. Instead, segmentation requires the added discipline of leveraging component commonality across product lines to create wide variety from a common component base - the "Taco Bell™ effect"⁴. This discipline is rapidly spreading from the desktop into Notebook PCs, which have traditionally had fewer common components, and across into other product categories. High commonality across products is a discipline that pays substantial dividends in flexibility, costs, speed, and quality.

The keys to offering increased product variety are the same tools and techniques that are used to make build-to-order supply chains. BTO supply chains utilize standardized components, increased commonality, flexible production techniques and continuous re-planning. The result: proliferation of products with much lower costs than BTS manufacturers, matching offerings to customer needs more closely, and generating revenue with higher margins.

Sustainable Cost Reductions

All high-tech manufacturers are familiar with the on-going price reductions in their industries. In some, such as the PC industry, price reductions have intensified so much lately that the winners in the market, such as Compaq, HP, Dell, Gateway, and IBM, are gradually forcing the losers out of business. Even in less fierce markets such as communications equipment, the price/performance ratio of modems has risen at an annual rate of 55% over the last 15 years⁵. Standardization of technologies and components have robbed manufacturers of many of those gains, handing them to consumers at one end and the owners of enabling technologies or standards, such as Microsoft, at the other.

⁴ This refers to the ability of fast-food chains to offer a wide variety of product from just a few basic raw materials.

⁵ The Annual Report on the Computer Industry, McKinsey & Co., Inc., 1997

The shift from Build To Stock to Build To Order supply chains offers new scope for managing and keeping pace with the continuous cost reductions in the industry. In particular, leaner inventories reduce the exposure of manufacturers to value erosion and help them to capture some of the benefits of cost reduction in their raw materials. All things being equal, gross margins in inventory-rich build to stock environments are 30% lower than for the same build-to-order supply chain. The source of the benefits comes from (1) eliminating finished goods inventories and (2) capturing cost reductions in raw materials.

Summary of Potential benefits from BTO

Depending on the operating environment, the total impact of the transition from Build-To-Stock to Build-To-Order can yield profit improvements of between 50 and 100% for high tech manufacturers, not including new demand-creation opportunities.

**The improvement potential from full "BTO" -
impact on net profit - ROUGH ESTIMATE**

FACTOR	High margin (25%)	Low-margin (10%)
▶ Capture perishable demand	2-7%	1-3%
▶ Improve product transitions	7-14%	3-6%
▶ Create demand	?	?
▶ Reduce inv. cost	0.5%	0.5%
▶ COGS reduction	1%	1%
▶ Reduce transitioning costs	1-1.5%	1-1.5%
PROFIT IMPACT	+ 11- 24%	+ 6 - 12%

Estimated + 50-100%
increase in net profit

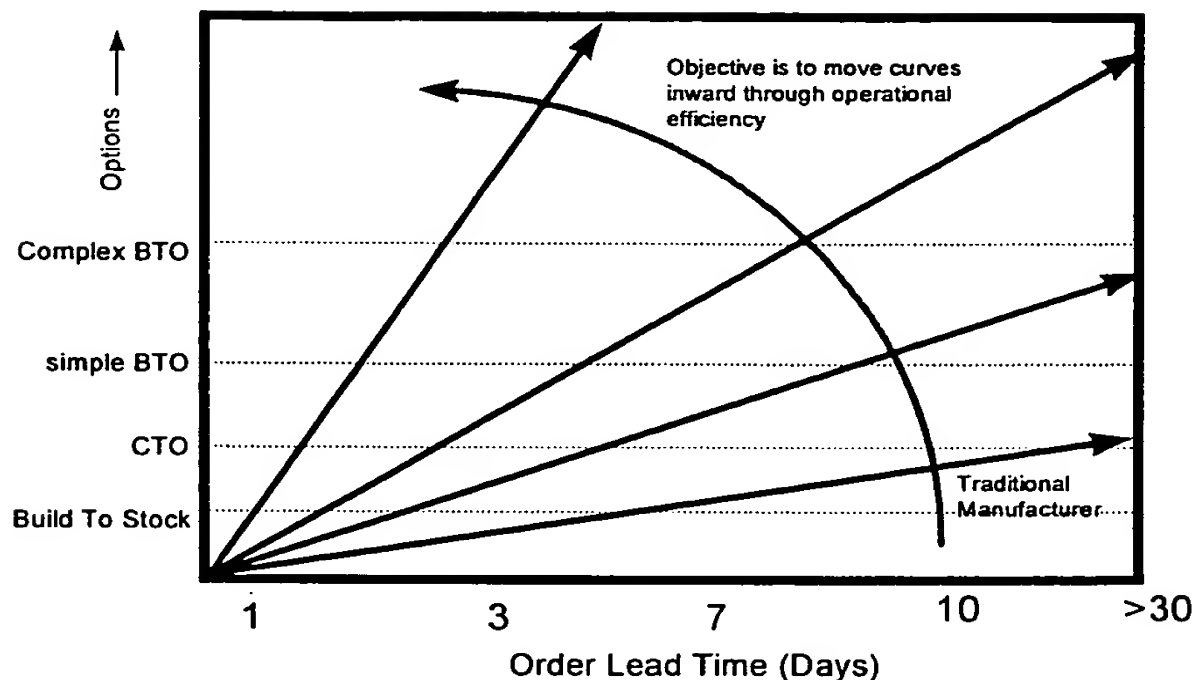
The Challenge of The Transition To Building To Order

The challenge of transitioning to a build-to-order supply chain comes largely from the elimination of the finished goods inventory buffers that have traditionally shielded manufacturers from the immediate volatility of the marketplace. The use of sophisticated planning tools permits build-to-order manufacturers to operate at the edge of instability - the point at which small perturbations in the supply chain threaten disaster where a quick response is lacking. A one-day delay in a key component is immaterial when there are 30 days of supply in the channel. It is a disaster when the order cycle time totals two days.

To approach the order fulfillment cycle times achieved by build-to-stock systems in a build-to-order environment, there are generally two approaches possible: (1) dramatically reduce actual manufacturing time and (2) reduce total cycle time from non-manufacturing or transport activities. The first case offers some scope for improvement as manufacturers learn to reduce set-up and change-over times, increase component commonality, and simplify the assembly process. In most cases, while progress can be made on the first option, there is far greater scope for progress on the total cycle time as manufacturing "touch time" represents just a small percentage of total order cycle time.

The case of an "average" high-volume office equipment manufacturer in a build-to-stock environment demonstrates the scope of the changes required to move to BTO. In total, the "touch time" required to assemble the finished product is just about 8 hours in the production line. In this case, it should be theoretically possible to move to a BTO system that ships in just 72 hours, against the old system of shipping product from stock without any change in the manufacturing process. All of the changes required are in the process of quoting, accepting, and planning the order.

Increased Compression Through Operations Efficiency



i2 Technologies has conducted performance diagnostics that demonstrate the close relationship between materials flows and planning cycle times. For a 10-fold improvement in the velocity of physical goods, a 100-fold improvement is required in the speed of decision making. To support High Speed Planning, a 1000-fold improvement is required in the speed of information flow. For a typical build-to-stock manufacturer, this implies:

- Production Cycle Time: 30 days to 3 days. Without finished goods inventories to buffer the flow of products, every product that is ordered must be assembled quickly. Instead of long runs of single products, the assembly system must be able to handle small runs of each product line at least once a day, sometimes more frequently
- Planning Cycle Time: 30 days to four times/day. Instead of gathering up re-supply requirements for inventory once a month, re-planning must be done several times each day. As new orders arrive, the planning system must quickly aggregate like products into the same production run over the next 72 hours.
- Supply Information: 1 day to 1 minute. In the past, there was time within the planning cycle to call a supplier and check availability. To do multiple what-if planning scenarios between each full planning cycle, manufacturers must have nearly instant access to supply information. In the short-term, substitutes such as "flex limits" supply contracts can be used, but over the longer term, direct linking of planning engines across the supply chain will be essential.

Time Compression In The Supply Chain

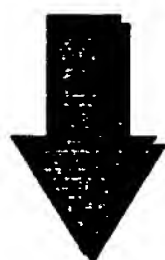
Order Lead Time
30 Days



3 Days

**10 x
Physical
Speed**

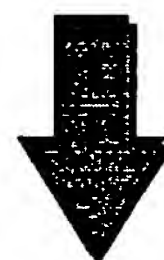
Replanning Cycle
1 Month



4 / Day

**100 x
Decisions
Speed**

Supply Information
1 Day



1 Minute

**1000 x
Information
Speed**

Not only does the transition to BTO require hundred-fold improvements in planning speed, it fundamentally changes the way other supply-chain planning activities are done and the results required of them. To support fundamental changes in manufacturing, other operations must revised:

- Order Promising. In a day-to-day manufacturing environment, it is harder to minimize the impact of volatility on the production process. Without fast, accurate order promising manufacturers risk either committing to goals they cannot meet or losing some of the value of the BTO process by quoting standard lead-times that are padded to allow for periodic overloads.
- Inventory Positioning. While total inventory levels are lower in BTO systems, the importance of raw-materials inventories increases dramatically. Some of the gains of the BTO transition will be lost if component inventories are allowed to balloon needlessly.

- Logistics Planning. The nature of in-bound and out-bound logistics changes and both become less predictable. Consequently, logistics planning activities such as load-building and tendering must be done as fast as the main manufacturing process. Additionally, out-bound logistics must often include merge-in-transit capabilities as there is no longer time to order and wait for other non-manufactured parts to arrive at the main assembly point. Expediting transportation is another option to shrink cycle times in transportation but may be reduced with high-speed logistics planning.

The transition to BTO supply chains poses additional challenges for the partners of a manufacturer in the supply chain. In particular, rapid and frequent changes in requirements may exceed the speed and capability of suppliers or channel partners to respond. For some products, the lead-time required for actual production may simply exceed the amount of time required by the manufacturer. In those cases, buffers of inventory will have to be retained, though the total inventory requirement will be lower with active collaboration than without and total supply chain inventory will be lower.

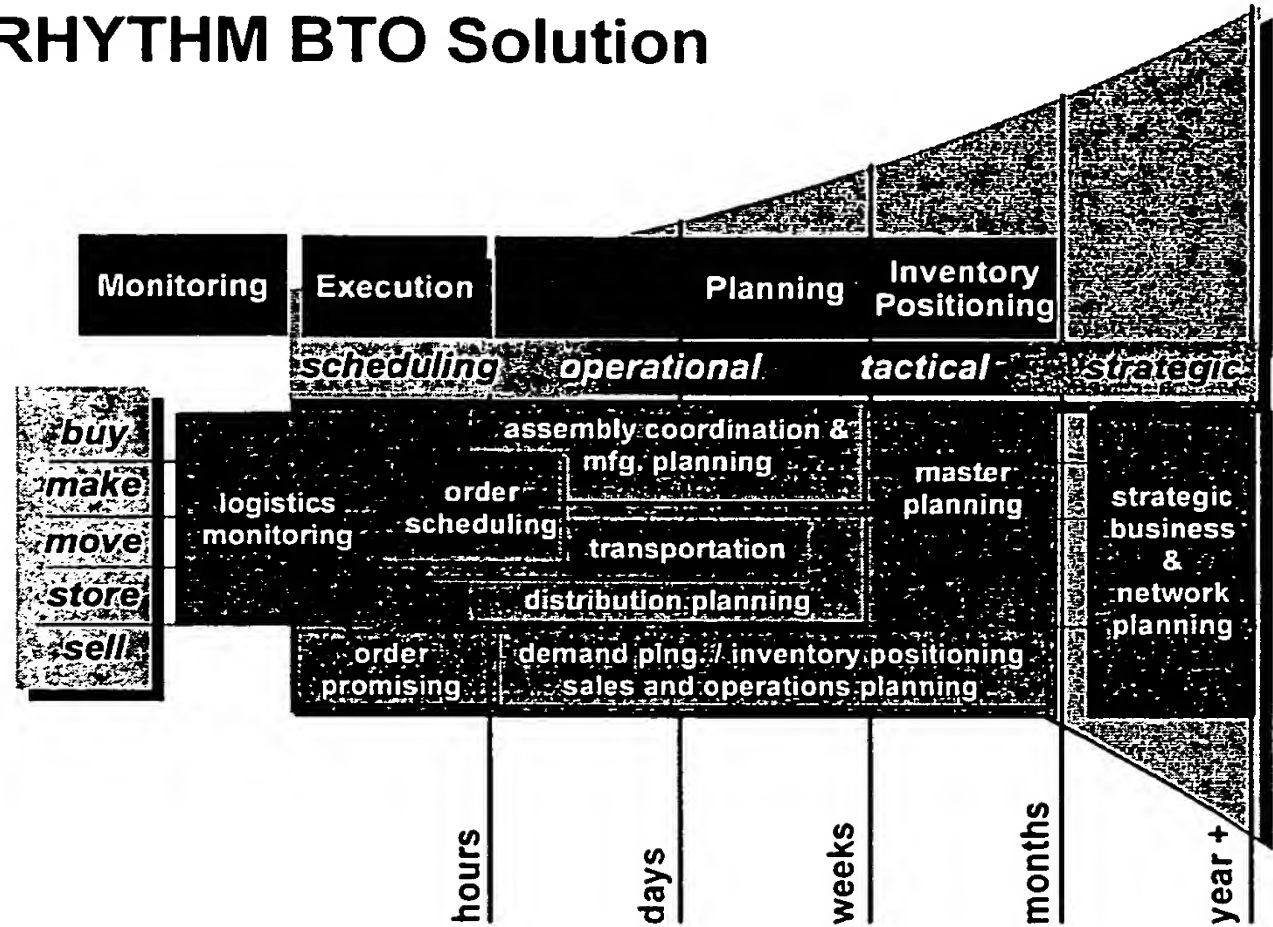
Operational capabilities for a BTO environment

- Broadly speaking there are three operational areas of importance in a BTO environment
 - Execution
 - Operational and tactical planning.
 - Global visibility and monitoring.



These operational areas address issues at various time scales, as summarized by the chart below.

RHYTHM BTO Solution



BTO execution

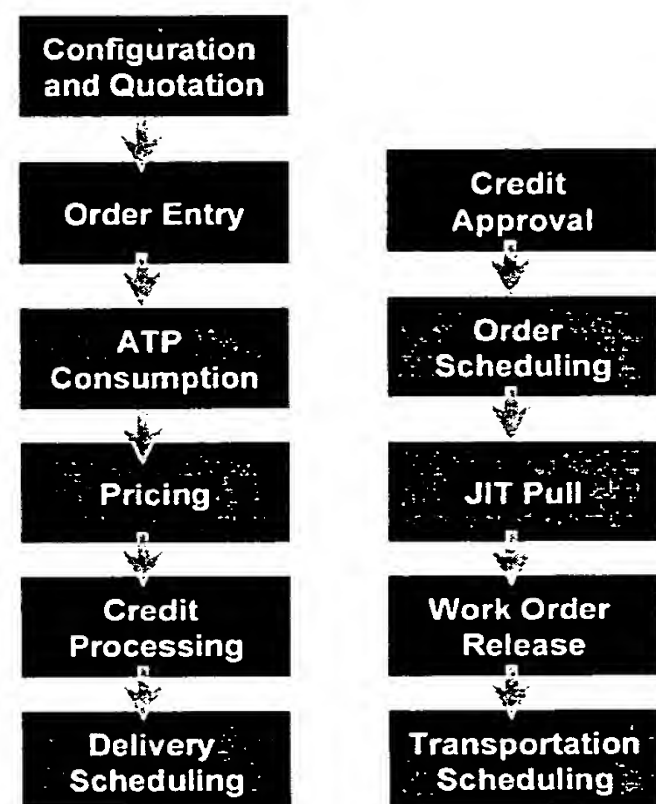
Execution of orders is largely a sequential process that happens in near-real-time. The main steps in the sequence are described in the figure below:

BTO Execution Process

- ▶ **Characteristics**
- ▶ Sequential
- ▶ Integration with Transaction Systems and Order Entry
- ▶ Decision Support Enabled
- ▶ Real Time



Leverages RHYTHM Solution



Characterized by speed and high levels of integration, the BTO execution process is enabled by the following key capabilities:

Configuration and Quoting:

- Provide near real time price and availability quoting for all products offered as "BTO" based on the "ability" to build which involves verifying many of the following key variables to provide an accurate order to delivery promise: alternate parts, alternate routings, the ability to make the subassembly, ability to procure from a supplier, availability of capacity, sourcing and transportation lead times.
- Ability to handle significant volumes of transactions, from several per day to thousands per hour. Moreover this ability must scale to the high volume order entry systems and the trend to "real time" web-based electronic commerce systems. Hundreds of orders and inquiries per second must often be processed during peak periods.

Credit Processing

- Ability to check and verify terms of credit such as open PO relations, creditworthiness, and confirmation of purchase with company purchasing.

Delivery Scheduling

- Ability to provide alternate delivery modes, partial shipment capability, while respecting bundling requirements (also known as married lines).
- Based on known manufacturing lead times and known transportation times, line items originating at different points must be scheduled to arrive at the same time. Optimization of the process assures that common carriers are used to minimize costs and the number of separate deliveries to the customer.

Order Scheduling

- Ability to break up a multi-line item into several orders, one for each item. If the items are stocked items (either in-house DC, or partner warehouse), issue an order for delivery to particular location, and reserve that item. If they are manufactured items, issue manufacturing orders to the factory that is the closest and has the right material availability. Develop a material plan for these orders, and reserve the necessary material. Schedule the order for execution.

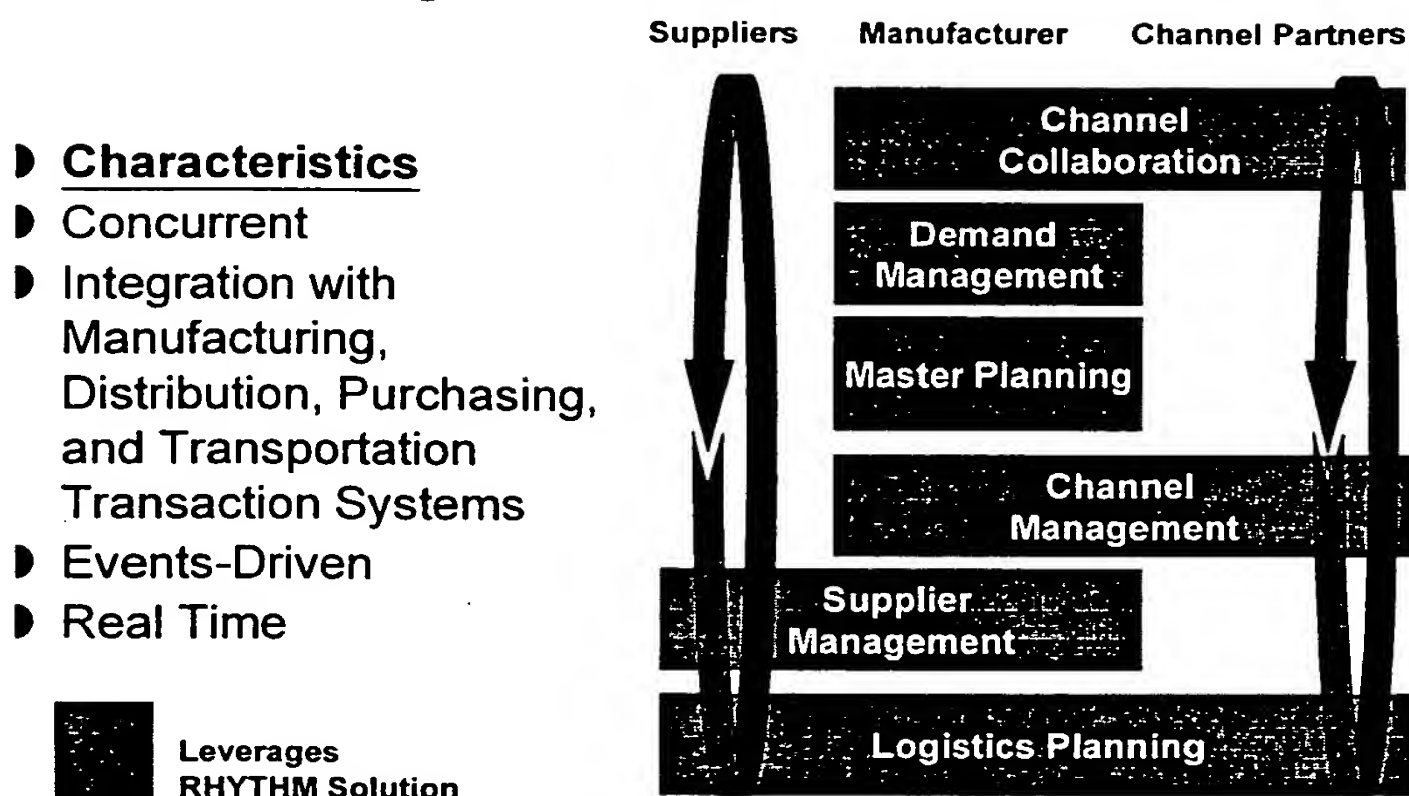
Transportation scheduling

- Schedule these orders to be picked up on common carriers for delivery to the customer. Since the different line items may originate at different locations, choose delivery route that costs the least by optimizing over other shipments that are in progress in the same window as this order. This capability may include scheduling a drop ship from a OEM parts distributor, or a merge in transit managed by a third party logistics partner.

BTO operational and tactical planning

This process consists of a number of closely interacting elements. Although, they are broken out by traditional domain of authority areas below, these processes should be tied together closely, with almost zero time lag to propagate information from demand to supplier, and from supplier to demand.

BTO Planning Process



Channel collaboration

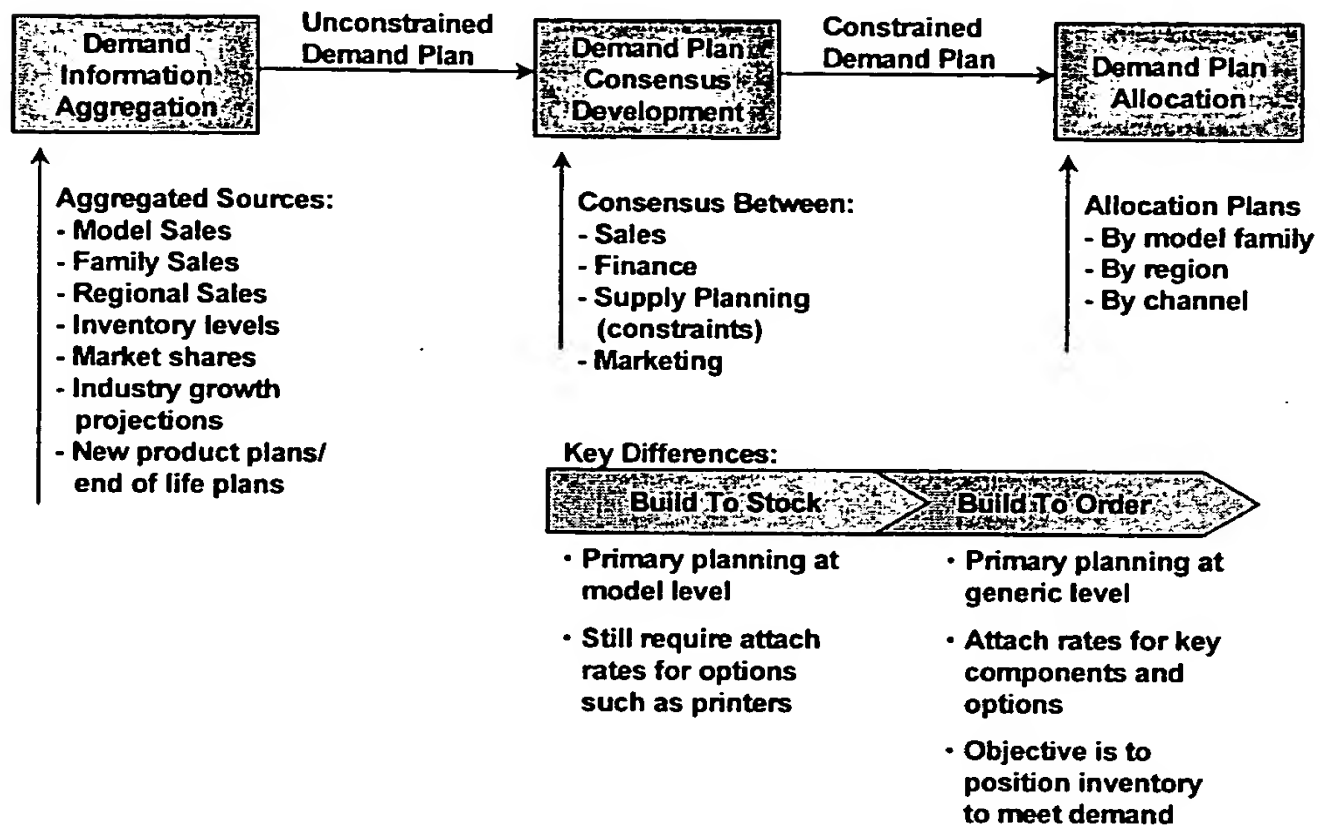
The key capabilities needed to promote channel collaboration include:

- Collaborative forecasting and demand aggregation along multiple levels to increase forecast accuracy.
- Share demand signals, current inventory levels as well as actual sales in near real time.
- Coordinate with third party partners for fast intelligent final assembly, either in-house or in the channel.
- Ability to work with channel partners at either the finished good level and/or component and option levels.
- Co-located hub warehouse planning.

Demand Management

A sample process for demand management is outlined below.

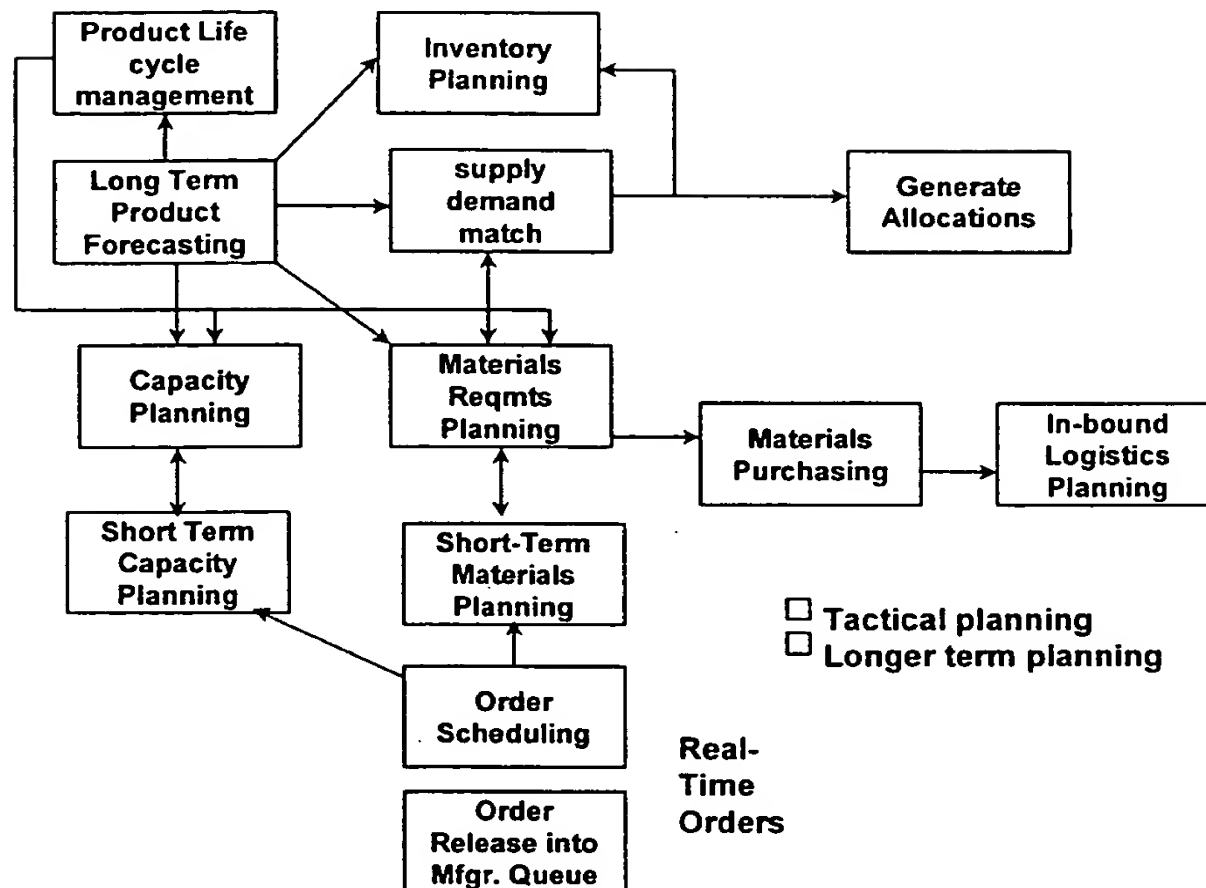
— Real Time
□ Planning



4

Some key capabilities needed to support this BTO demand planning process.

- Ability to model product life cycles of new product demand.
- Recognize that some supplies feed multiple demand streams, and how a new product cannibalizes the demand from older ones.
- With the proliferation of end item configurations, it becomes almost impossible to forecast at the end item level. Hence, one needs the ability to plan "base" systems, and use "attach rates" of various options and assembly modules, i.e. forecasting at the component level.
- Ability to support consensus based forecasting to involve multiple functions in developing one plan

Master planning.

Some key capabilities to support the BTO Master Planning and Manufacturing Planning Process.

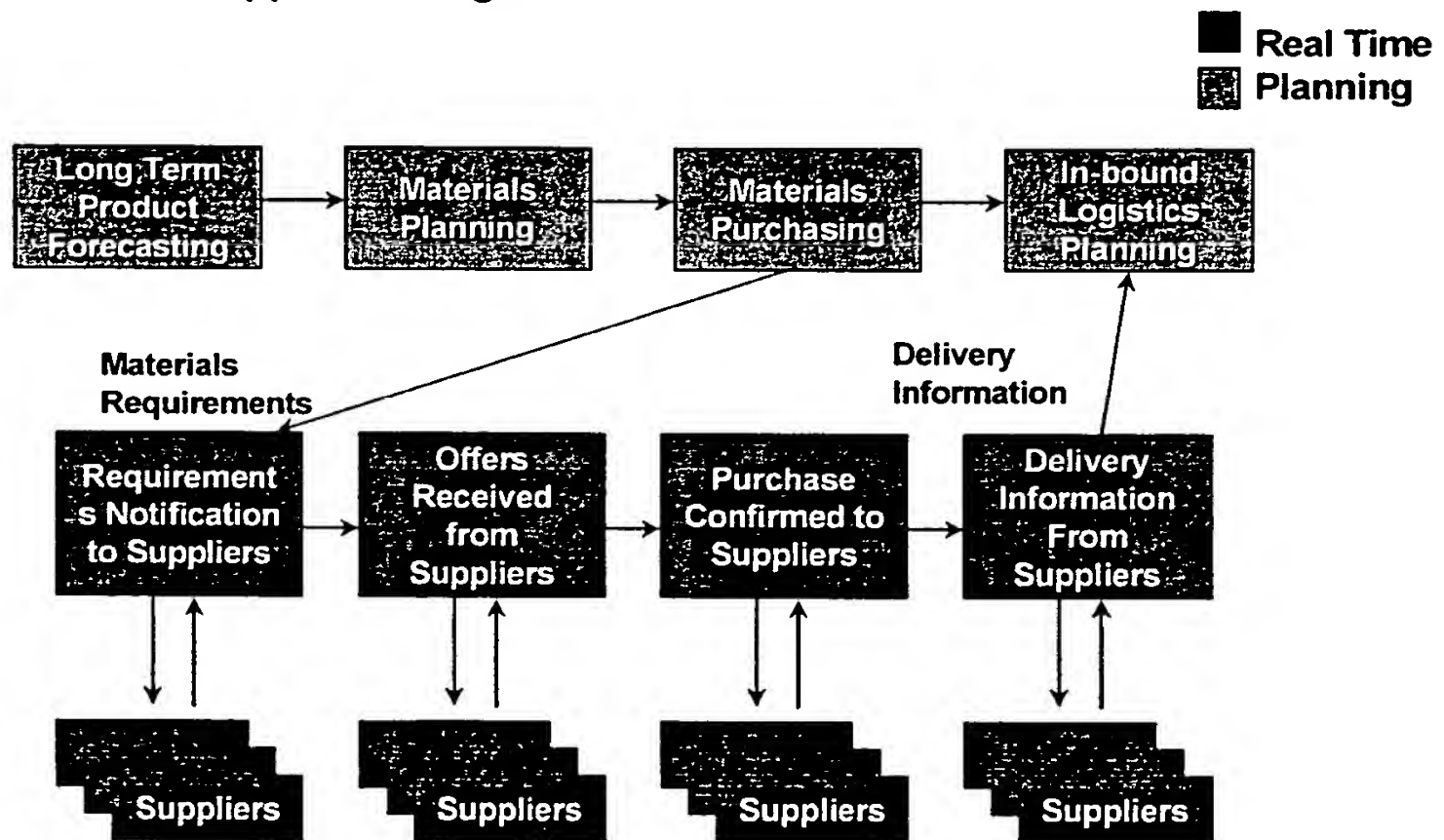
- Rapid planning and replanning
- Global visibility of supply chain and inventory
- Tactical inventory management
- Coordinate complex assembly and distribution across multiple sites and with alternate parts
- Ability to represent shared material and capacity constraints across production lines/sites
- Optimize product mix decisions while respecting customer priorities using a variety of business rules including highest profit.
- Quick visibility of profit and cash-flow implications of options/decisions.
- The ability to coordinate multiple demand types. Example: Consume long term build ahead plan with firm orders

- Ability to use planning bills of material to plan critical long lead time items
- Ability to use flexible volume/mix limits at suppliers
- Ability to define and adapt to multiple inventory modes over time (dynamic BTS/BTO configurations).
- **Channel Management**

Some of the key capabilities to manage channels include:

- Ability to allocate supply along multiple market dimensions - to minimize gaming and to ensure supply to key customers and markets - examples include the ability to allocate to channel partners and their end customers.
- Ability to allocate critical parts, not just end items to multiple tiers in the channel, including end customers.

Supplier Management



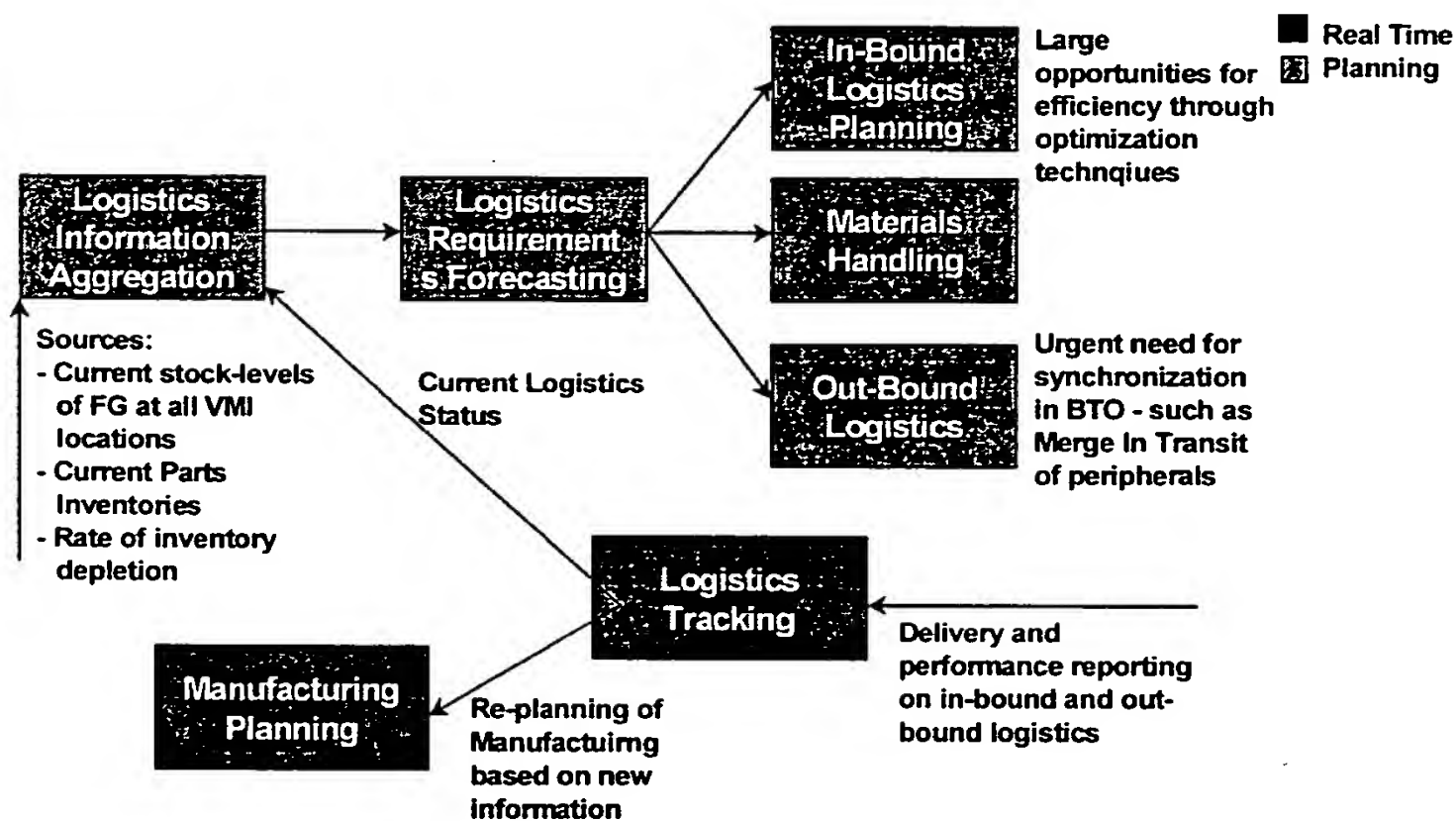
Capabilities needed to support a BTO environment supplier management

- Rapid (near real-time) propagation of demand information to suppliers, especially those with dedicated supplier capacity.
- Flexible limits monitoring and management



- Visibility into supplier (first tier and second tier, in some cases) available capacity and on hand inventory.
- Proactive alerts to increase supplier responsiveness (early warnings to suppliers about imminent increase/decreases and design changes).
- Real time exception management.
- Support different business policies with different vendors
- Ability to ask for, analyze and accept bids from multiple suppliers automatically.
- Minimize the time to work with suppliers across multiple time zones.

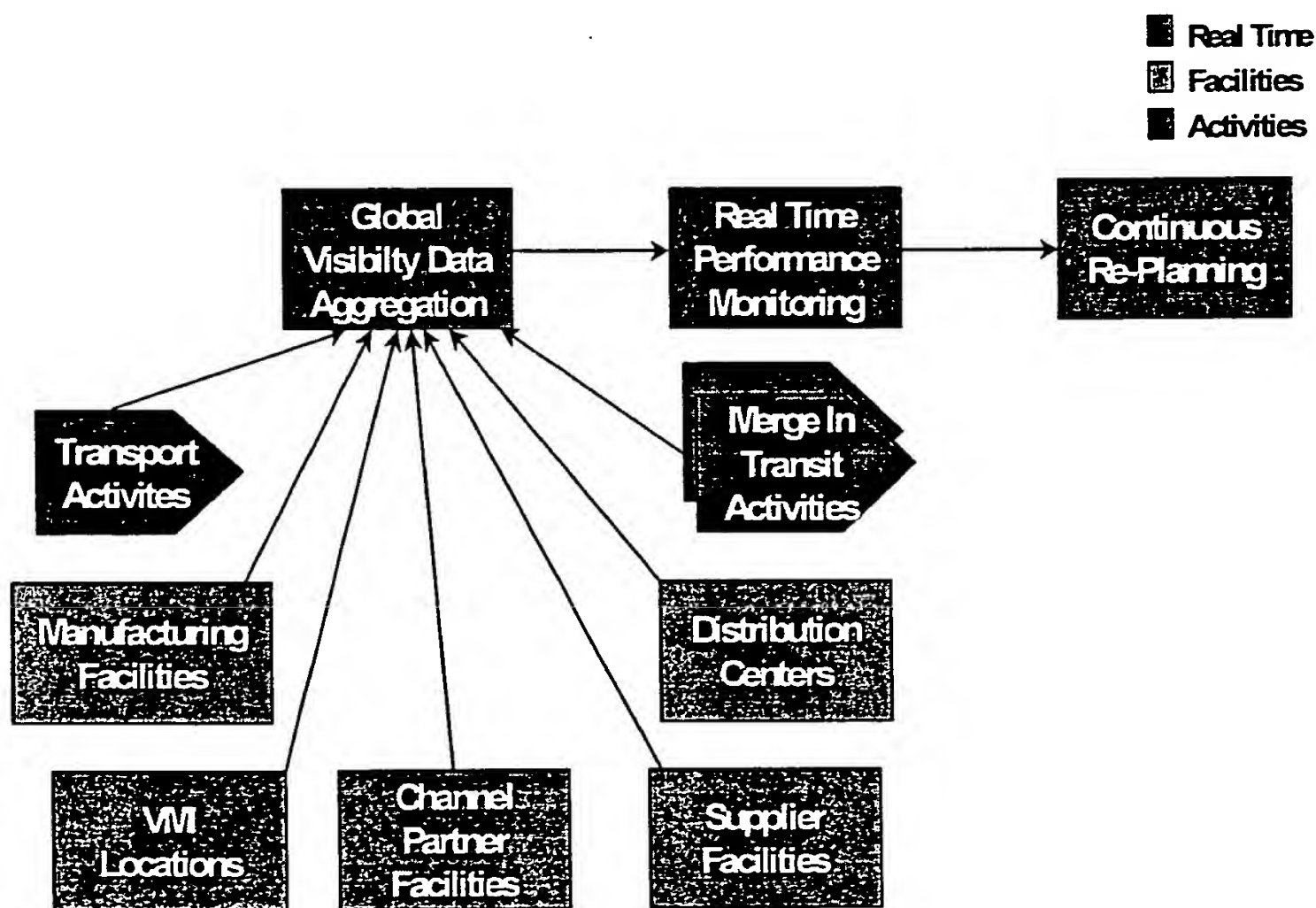
Logistics Planning



Some of the capabilities needed for logistics planning include:

- Ability to build and tender loads to carriers
- Ability to execute delivery in a variety of ways including drop shipments and merge in transit.
- Ability to manage the full financial requirements of working with transportation carriers.
- Ability to optimize the total physical flows to maximize reliability and minimize costs.
- Coordinate preparation of customs documentation and synchronize flow with physical flow of goods, including import, export, bills of lading, small parcel and all other documentation.

Global visibility.



Monitor overall execution, both manufacture as well as outbound logistics, till final delivery to customer. This ensures that any problems are detected early and are fixed before they become major customer service problems. Specific capabilities include:

- Interfaces to information feeds of third party logistics providers (EDI, Web Enabled, API)
- Inventory monitoring at VMI and distribution location centers
- Tracking of order through manufacturing facilities.
- Ability to disaggregate information of shipments and containers into customer order information, i.e. know which customers are affected by problems at a shipment or container level.
- Manage to exceptions
- Manage third party logistics providers

Summary and conclusions

Extreme performance supply chains characterized by high-speed BTO operations are designed to deal with many of the challenges of operating in the High Tech marketplace. Some of the major benefits by having customer order information influence manufacturing include:

- the ability to operate with lower levels of inventory that are maintained in flexible form.
- increased inventory turns through higher velocity of material flow through the system
- reduced exposure to price erosion, and exploiting price erosion by postponing purchase of raw materials.
- manageable responsiveness to demand volatility that comes from holding inventory in the more flexible component form
- more manageable product transitions through smaller amounts of inventory clogging the channel and faster responsiveness to market changes
- proliferate products with minimal incremental cost
- capture perishable demand by combining improved responsiveness with fast, accurate promising capability

The key to realizing these benefits is to create planning and execution systems that reflect the five basic skills that have been high-lighted in this paper: the ability to plan at great speed, with extraordinary levels of accuracy and detail - high fidelity, and to do so under considerable uncertainty. When combined with a focus on events rather than static/regular planning cycles and global visibility across the system, the right environment exists to succeed with BTO.

This document has described some of the operational capabilities needed to achieve this excellence. Naturally, systems and process capability must be complemented by operational excellence in a number of other areas, including performance measurement, incentives that align uniformly across the supply chain, and a commitment to increased component commonality, to name a few.

The i2 Rhythm suite of software and associated diagnostic and implementation services can help manufacturers develop and implement a road-map of capabilities, assess the size of the opportunities from BTO, and create and execute upon realistic implementation plans. The result gives our clients the speed and reliability in planning and execution that they need to forge ahead in today's competitive marketplace.